II. AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1 - 53 (Canceled)

54. (new) A solar cell comprising:

a germanium substrate; and

a layer of material including In and P disposed directly on the germanium substrate.

55. (new) A solar cell as defined in claim 54, wherein the layer of material is InGaP.

56. (new) A solar cell as defined in claim 54, further comprising a top solar subcell formed from InGaP, a middle solar subcell formed from GaAs, and a lower solar subcell formed in the germanium substrate.

57. (new) A solar cell as defined in claim 54, further comprising a diffused photoactive germanium junction in the substrate.

58. (new) A solar cell as defined in claim 57, wherein the diffused junction is formed by the diffusion of arsenic into the germanium substrate.

59. (new) A solar cell as defined in claim 54, wherein the layer of material has a lattice parameter substantially equal to the lattice parameter of the germanium substrate.

60. (new) A solar cell as defined in claim 54, wherein the layer has a thickness equal to 350 Angstroms or less.

61. (new) A solar cell defined in claim 54, wherein the cell is capable of photoactively converting radiation ranging from approximately ultraviolet (UV) radiation to radiation having a wavelength of approximately 1800 nm.

62. (new) A solar cell defined in claim 58, wherein the junction in the germanium substrate layer is located between 0.3 .mu.m and 0.7 .mu.m from the top surface of the germanium substrate.

63. (new) A solar cell as defined in claim 57, wherein the diffused germanium substrate forms a first cell layer and has a dopant diffusion profile that optimizes the current and voltage generated therefrom.

64. (new) A solar cell as defined in claim 54, wherein the cell has 1 sun AM0 efficiencies in excess of 26%.

65. (new) A solar cell comprising:

a germanium substrate;

a solar subcell layer overlying said substrate and composed at least in part of GaAs; and

a barrier layer overlying said substrate and underneath said GaAs-containing layer and functioning to inhibit the diffusion of arsenic from the GaAs-containing layer into the germanium substrate.

66. (new) A solar cell as defined in claim 65, further comprising a solar subcell formed in the germanium substrate.

67. (new) A solar cell as defined in claim 66, wherein the subcell formed in the germanium substrate is formed from a n-type germanium overlying a p-type germanium substrate.

68. (new) A solar cell as defined in claim 67, wherein the n-type germanium layer is formed by diffusion of arsenic into the germanium substrate.

69. (new) A solar cell a defined in claim 67, wherein the n-type germanium layer is formed by diffusion of phosphorous into the germanium substrate.

70. (new) A solar cell as defined in claim 67, wherein the n-type germanium layer is formed by diffusion of both arsenic and phosphorous into the germanium substrate.

71. (new) A solar cell as defined in claim 65, wherein the barrier layer is composed of InGaP; InP, or GaP.

72. (new) A solar cell as defined in claim 65, wherein the barrier layer has a thickness of approximately 350 Angstroms or less.

73. (new) A solar cell as defined in claim 65, further comprising a two step diffusion profile in the germanium substrate with two different dopants.

74. (new) A solar cell comprising:

a first cell including a germanium (Ge) substrate having a diffusion region doped with n-type dopants including phosphorus and arsenic, wherein the upper portion of such diffusion region has a higher concentration of phosphorus (P) atoms than arsenic (As) atoms, and

a second cell including a layer of either gallium arsenide (GaAs) or indium gallium arsenide (InGaAs) disposed over the substrate.

75. (new) A solar cell as recited in claim 74, further comprising a nucleation layer deposited over said substrate that has a lattice parameter substantially equal to the lattice parameter of the germanium substrate.

76. (new) A solar cell as recited in claim 75, wherein the nucleation layer is a compound of InGaP.

77. (new) A solar cell as recited in claim 75, wherein the nucleation layer has a thickness equal to 350 Å or less.

78. (new) A solar cell defined in claim 74, wherein the solar cell is capable of photoactively converting radiation from approximately ultraviolet (UV) radiation to radiation having a wavelength of approximately 1800 nm.

79. (new) A solar cell defined in claim 74, wherein the junction in the germanium substrate is located between 0.3 .mu.m and 0.7 .mu.m from the top surface of the germanium substrate.

80. (new) A solar cell as defined in claim 74, wherein the diffused phosphorus and arsenic in the germanium substrate has a diffusion profile that optimizes the current and voltage generated in the first cell.

81. (new) A solar cell as defined in claim 75, wherein the solar cell has 1 sun AM0 efficiencies in excess of 26%.

82. (new) A solar cell as defined in claim 74, further comprising a third cell disposed over the second cell layer.

83. (new) A solar cell comprising:

an upper subcell structure including arsenic (As), and a lower subcell formed from a p-type material including first and second diffusion sublayers, wherein the photoactive junction is formed by arsenic (As) and phosphorus (P) converting a upper diffusion layer to n-type, and at least a portion of the second diffusion sublayer is disposed deeper into the p-type material than the first diffusion sublayer.

84. (new) A solar cell as recited in claim 83, wherein the first diffusion sublayer has a higher concentration of phosphorus (P) atoms than arsenic (As) atoms, and the second diffusion sublayer has a higher concentration of arsenic (As) than phosphorus (P) atoms.

85. (new) A solar cell as recited in claim 83, further comprising a nucleation layer deposited over said lower subcell that has a lattice parameter substantially equal to the lattice parameter of the top layer of the subcell.

86. (new) A solar cell as recited in claim 85, wherein the nucleation layer includes InGaP.

87. (new) A solar cell as recited in claim 85, wherein the nucleation layer has a thickness equal to 350 Å or less.

88. (new) A solar cell defined in claim 85, wherein the junction in the lower subcell is located between 0.3 .mum and 0.7 .mu.m from the top surface of the lower subcell.

89. (new) A solar cell as defined in claim 85, wherein the depth of the first and second diffusion sublayers is selected to create a dopant diffusion profile that optimizes the current and voltage generated in the lower subcell.

90. (new) A solar cell as defined in claim 85, further comprising a third solar subcell disposed over the upper subcell.

91. (new) A method for controlling the diffusion of a dopant into a first layer of semiconductor material during the fabrication of a multi-layer semiconductor structure, comprising:

(a) depositing a nucleation layer over a first layer, of the semiconductor structure;

(b) depositing an device layer containing a dopant over the nucleation layer,

wherein the dopant includes arsenic (As) and the nucleation layer serves as a diffusion barrier to the arsenic dopant such that diffusion of the dopant into the first layer is limited in depth by the nucleation layer.

92. (new) The method as recited in claim 91, wherein the nucleation layer is a material that has a similar lattice parameter as the first layer.

93. (new) The method as recited in claim 91, wherein the first layer is germanium (Ge) and the nucleation layer comprises InGaP.

94. (new) The method as recited in claim 91, wherein the nucleation layer has a thickness equal to 350 Å or less.

95. (new) The method as recited in claim 91, wherein a two-step diffusion profile is formed in the first layer that results in a shallow n-p junction in the layer.

96. (new) The method as recited in claim 91, wherein material contained in the nucleation layer serves as a source of a dopant that forms an n-p junction in the first layer.

97. (new) The method as recited in Claim 91, wherein diffusion of the dopant into the first layer primarily involves solid state diffusion.